10. Recalculations and Improvements

Each year, emission and sink estimates are recalculated and revised for all years in the *Inventory of U.S. Greenhouse Gas Emissions and Sinks,* as attempts are made to improve both the analyses themselves, through the use of better methods or data, and the overall usefulness of the report. In this effort, the United States follows the Intergovernmental Panel on Climate Change (IPCC) *Good Practice Guidance* (IPCC 2000), which states, "It is good practice to recalculate historic emissions when methods are changed or refined, when new source categories are included in the national inventory, or when errors in the estimates are identified and corrected."

The results of all methodology changes and historical data updates are presented in this section; detailed descriptions of each recalculation are contained within each source's description contained in this report, if applicable. Table 10-1 summarizes the quantitative effect of these changes on U.S. greenhouse gas emissions and Table 10-2 summarizes the quantitative effect on U.S. sinks, both relative to the previously published U.S. Inventory (i.e., the 1990 through 2003 report). These tables present the magnitude of these changes in units of Tg CO_2 Eq. In addition to the changes summarized by the tables below, three new sources—silicon carbide consumption, lead production, and zinc production—have been added to the current Inventory.

The Recalculations Discussion section of each source presents the details of each recalculation. In general, when methodological changes have been implemented, the entire time series (i.e., 1990 through 2003) has been recalculated to reflect the change, per IPCC *Good Practice Guidance*. Changes in historical data are generally the result of changes in statistical data supplied by other agencies. References for the data are provided for additional information.

The following emission sources, which are listed in descending order of absolute average annual change in emissions from 1990 through 2003, underwent some of the most important methodological and historical data changes. A brief summary of the recalculation and/or improvement undertaken is provided for each emission source.

- *Land Use, Land-Use Change, and Forestry*. The most influential of the changes in the Land Use, Land-Use Change, and Forestry sector occurred in calculations for forest carbon stocks. These changes included the use of survey data, utilizing all available state surveys in the FIADB with RPA data used as necessary. There were also changes in calculations for agricultural soil carbon stocks, the most significant being the implementation of the Tier 3 model-based approach for mineral soils. In addition, these recalculations reflect the inclusion of new categories to the LULUCF chapter (e.g. Grassland Remaining Grassland). Overall, these changes, in combination with adjustments in the other sources/sinks, resulted in an average annual increase in net flux of CO_2 to the atmosphere from the Land Use, Land-Use Change, and Forestry sector of 155.0 Tg CO_2 Eq. (17 percent) for the period 1990 through 2003.

- *Agricultural Soil Management*. Changes occurred as a result of minor adjustments in activity data and the use of an updated version of the DAYCENT model. The DAYCENT model was revised to more realistically represent the grain filling period and life span of crops. Additionally, this year a different soils database was used for model simulations. Overall, changes resulted in an average annual increase in N_2O emissions from agricultural soil management of 30.6 Tg CO_2 Eq. (12 percent) for the period 1990 through 2003.

- *Non-Energy Use of Fuels.* There were several refinements to the methodology for calculating emissions and storage for petrochemical feedstocks. There was a thorough review of system boundaries on the mass balance, which involved reconciling disparities in data for production and consumption, and making corresponding revisions to the import/export calculations. Three additional NEU fates were incorporated into the calculations—antifreeze and deicers, food additives, and silicone rubber—and refinery wastewaters was removed from the mass balance. There were also revisions to the data used to calculate storage factors. Overall, changes resulted in an average annual increase in CO_2 emissions from non-energy use of fuels of 15.2 Tg CO_2 Eq. (13 percent) for the period 1990 through 2003.

- *Petroleum Systems*. There was one major change to this source with respect to previous inventories.

Previously, offshore petroleum production emissions were calculated as eight separate sources. New analysis of the 2000 GOADS report (MMS 2005c) yields comprehensive shallow and deep water sources and related emissions factors, which account for all offshore emissions. The sources from the GOADS analysis have replaced the eight sources from previous inventories. Overall, changes resulted in an average annual increase in CH_4 emissions from petroleum systems of 11.8 Tg CO_2 Eq. (63 percent) for the period 1990 through 2003.

- *CO_2 from Fossil Fuel Combustion*. The most important change affecting historical estimates for fossil fuel combustion was the correction of overestimated emissions from the industrial sector. Previously, a portion of industrial sector fuels that are exported as petrochemical feedstocks or used in industrial processes were not subtracted from fuels consumed for energy purposes. Overall, this change, along with several other alterations, resulted in an average annual decrease of 5.6 Tg CO_2 Eq. (0.1 percent) in CO_2 emissions from fossil fuel combustion for the period 1990 through 2003.

- *Landfills*. Changes to historical data were a result of updating the EIA, LMOP, and flare vendor databases. Average annual emissions increased over the time series because of a decrease in estimates of CH_4 recovered for gas-to-energy projects and flaring. Overall, changes resulted in an average annual increase in CH_4 emissions from landfills of 4.7 Tg CO_2 Eq. (4 percent) for the period 1990 through 2003.

- *Natural Gas Systems*. The most significant changes to this source resulted from methodological revisions in calculating offshore natural gas production emissions. Previously, these emissions were calculated as five separate sources. New analysis of the 2000 GOADS report (MMS 2005c) yields comprehensive shallow and deep water sources and related emissions factors, which account for all offshore emissions. The sources from the GOADS report have replaced the five sources from previous inventories. Overall, changes resulted in an average annual decrease in CH_4 emissions from natural gas systems of 4.5 Tg CO_2 Eq. (3 percent) for the period 1990 through 2003.

- *Biomass Combustion.* The historical data for wood biomass consumption was adjusted, which resulted in an average annual decrease in emissions from wood biomass and ethanol consumption of 2.0 Tg CO_2 Eq. (0.9 percent) from 1990 through 2003.

- *Substitution of Ozone Depleting Substances.* Assumptions to the Vintaging Model were updated based on changes in chemical substitution trends, market sizes, growth rates, and charge sizes. Overall, changes resulted in an average annual decrease in HFC and PFC emissions from the substitution of ozone depleting substances of 2.0 Tg CO_2 Eq. (3 percent) for the period 1990 through 2003.

Table 10-1: Revisions to U.S. Greenhouse Gas Emissions (Tg CO_2 Eq.)

Gas/Source	1990		1998	1999	2000	2001	2002	2003
CO_2	**(4.3)**		**13.0**	**17.1**	**6.3**	**50.4**	**19.1**	**36.2**
Fossil Fuel Combustion	(15.2)		(6.9)	(3.5)	(11.4)	38.9	0.3	19.5
Non-Energy Use of Fuels	9.2		17.4	19.0	16.0	10.9	17.6	15.5
Natural Gas Flaring	NC		NC	NC	NC	NC	+	0.1
Cement Manufacture	NC		NC	NC	NC	NC	NC	0.1
Lime Manufacture	+		+	+	+	+	+	+
Limestone and Dolomite Use	NC		NC	NC	+	NC	NC	NC
Soda Ash Manufacture and Consumption	NC		NC	NC	NC	NC	NC	+
CO_2 Consumption	+		+	+	+	+	+	+
Waste Combustion	NC		NC	NC	(0.1)	(0.1)	0.1	0.6
Titanium Dioxide Production	NC		NC	NC	NC	NC	NC	+
Aluminum Production	0.7		0.6	0.6	0.5	0.4	0.4	0.4
Iron and Steel Production	(0.4)		0.3	(0.6)	(0.4)	(1.1)	(0.5)	(0.4)
Ferroalloy Production	NC		NC	NC	NC	NC	NC	(0.2)
Ammonia Manufacture & Urea Application	NC		NC	NC	+	+	(0.1)	(0.3)
Petrochemical Production	NC		NC	NC	NC	NC	NC	NC
Phosphoric Acid Production	NC		NC	NC	NC	NC	NC	NC
Silicon Carbide Consumption[a]	0.1		0.2	0.1	0.1	0.1	0.1	0.1
Lead Production[a]	0.3		0.3	0.3	0.3	0.3	0.3	0.3

Zinc Production[a]	0.9	1.1	1.1	1.1	1.0	0.9	0.5
Net CO_2 Flux From Land Use, Land-Use Change, and Forestry	*131.7*	*137.0*	*60.4*	*62.9*	*58.9*	*57.8*	*53.2*
International Bunker Fuels	*NC*	*NC*	*(0.1)*	*+*	*(0.1)*	*NC*	*(0.1)*
Biomass Combustion	*+*	*NC*	*NC*	*NC*	*NC*	*(12.9)*	*(14.7)*
CH_4	**12.7**	**10.4**	**11.7**	**12.8**	**13.4**	**17.3**	**19.4**
Stationary Sources	+	(0.1)	(0.1)	(0.1)	+	(0.2)	(0.2)
Mobile Sources	(0.1)	(0.1)	+	0.1	0.2	0.3	0.3
Coal Mining	NC	+	0.1	+	(0.1)	0.1	1.0
Abandoned Coal Mines	+	(0.3)	(0.4)	(0.5)	(0.4)	(0.3)	(0.6)
Natural Gas Systems	(1.6)	(6.4)	(5.7)	(5.4)	(6.2)	(5.3)	(1.2)
Petroleum Systems	14.5	11.2	10.7	10.3	9.9	9.7	8.8
Petrochemical Production	NC	NC	NC	NC	NC	NC	NC
Silicon Carbide Production	NC	NC	NC	NC	NC	NC	NC
Iron and Steel Production	NC	NC	NC	NC	NC	NC	NC
Enteric Fermentation	NC	+	+	+	0.1	0.1	0.1
Manure Management	+	+	(0.6)	+	(0.1)	+	+
Rice Cultivation	NC	NC	NC	+	NC	NC	NC
Field Burning of Agricultural Residues	+	+	+	+	+	+	+
Landfills	0.1	5.9	7.6	8.3	10.0	13.0	11.3
Wastewater Treatment	(0.1)	+	+	+	+	+	(0.2)
International Bunker Fuels	NC	NC	+	+	+	NC	+
N_2O	**12.9**	**32.9**	**37.2**	**14.3**	**27.0**	**26.9**	**9.3**
Stationary Sources	+	+	+	(0.1)	+	(0.3)	(0.3)
Mobile Sources	(0.3)	(0.5)	(0.6)	+	1.0	1.9	2.7
Adipic Acid	NC	NC	NC	NC	NC	NC	0.2
Nitric Acid	NC	NC	NC	NC	NC	NC	0.9
Manure Management	+	+	+	+	+	+	+
Agricultural Soil Management	13.1	33.4	37.8	14.3	25.8	25.2	5.7
Field Burning of Agricultural Residues	+	+	+	+	+	+	+
Human Sewage	(0.1)	(0.1)	(0.1)	+	+	(0.1)	(0.1)
N_2O Product Usage	NC	NC	NC	NC	NC	NC	NC
Waste Combustion	0.1	+	+	+	0.1	0.1	0.1
Settlements Remaining Settlements	0.1	+	+	+	+	+	0.2
Forest Land Remaining Forest Land	NC	NC	NC	NC	NC	NC	NC
International Bunker Fuels	NC	NC	+	+	+	NC	+
HFCs, PFCs, and SF_6	**(0.5)**	**(2.3)**	**(3.3)**	**(4.2)**	**(4.6)**	**(5.6)**	**(6.0)**
Substitution of Ozone Depleting Substances	NC	(2.1)	(3.0)	(3.8)	(4.6)	(5.3)	(6.0)
Aluminum Production	0.1	+	+	+	NC	+	+
HCFC-22 Production	NC	NC	NC	NC	NC	NC	NC
Semiconductor Manufacture	NC	NC	NC	NC	NC	NC	NC
Electrical Transmission and Distribution	(0.6)	(0.3)	(0.3)	(0.4)	(0.1)	(0.2)	(0.1)
Magnesium Production and Processing	+	+	+	+	+	(0.1)	+
Net Change in Total Emissions[b]	**20.9**	**53.9**	**62.7**	**29.1**	**86.2**	**57.7**	**58.9**
Percent Change	**0.3%**	**0.8%**	**0.9%**	**0.4%**	**1.3%**	**0.8%**	**0.9%**

+ Absolute value does not exceed 0.05 Tg CO_2 Eq. or 0.05 percent.
NC (No Change)
[a] New source category relative to previous inventory.
[b] Excludes net CO_2 flux from Land Use, Land-Use Change, and Forestry, and emissions from international bunker fuels and biomass combustion.
Note: Totals may not sum due to independent rounding.

Table 10-2: Revisions to Net Flux of CO_2 to the Atmosphere from Land Use, Land-Use Change, and Forestry (Tg CO_2 Eq.)

Component	1990	1998	1999	2000	2001	2002	2003
Forest Land Remaining Forest Land	175.9	186.7	113.9	116.9	116.9	116.9	116.9
Cropland Remaining Cropland	(25.0)	(20.3)	(20.3)	(20.5)	(20.7)	(21.3)	(22.0)
Land Converted to Cropland[a]	1.5	(2.8)	(2.8)	(2.8)	(2.8)	(2.8)	(2.8)
Grassland Remaining Grassland[a]	(4.5)	7.5	7.5	7.4	7.4	7.4	7.3
Land Converted to Grassland[a]	(17.6)	(21.1)	(21.1)	(21.1)	(21.1)	(21.1)	(21.1)
Settlements Remaining Settlements	1.5	(13.0)	(16.7)	(17.0)	(20.8)	(21.1)	(25.0)
Net Change in Total Flux	**131.7**	**137.0**	**60.4**	**62.9**	**58.9**	**57.8**	**53.2**
Percent Change	**12.6%**	**15.5%**	**7.3%**	**7.6%**	**7.1%**	**7.0%**	**6.4%**

+ Absolute value does not exceed 0.05 Tg CO_2 Eq. or 0.05 percent.
NC (No Change)
[a] Estimates for this category was reported in Cropland Remaining Cropland in the previous inventory.
Note: Numbers in parentheses indicate a decrease in estimated net flux of CO_2 to the atmosphere, or an increase in net sequestration.
Note: Totals may not sum due to independent rounding.